D&D of a Former Beryllium Machine Shop

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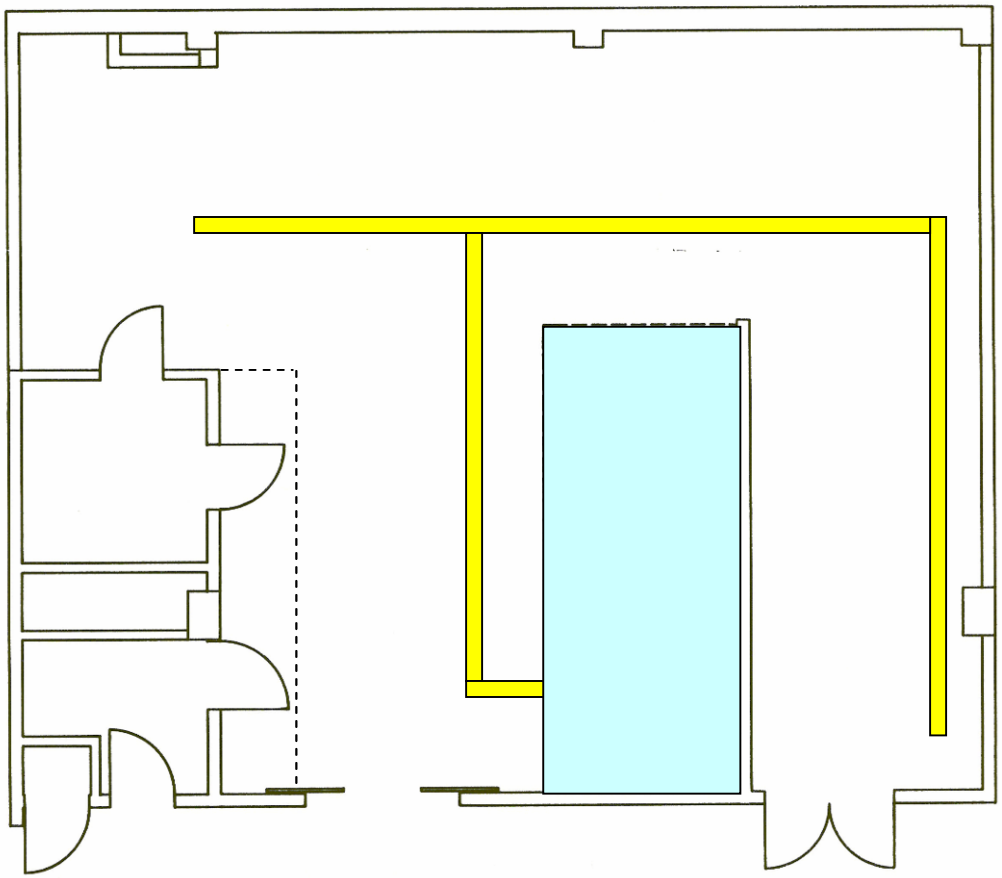
Background

- TA-3, building 39, room 16 served as the principal beryllium machine shop at LANL from 1953 through 1999.
- By 2000, beryllium machining operations were transferred to the Beryllium Technology Facility.
- In 2007, funding was secured to remove the beryllium hazard and return this space to useable condition.
- Security concerns over small classified parts entrapped within the ventilation system further complicated the already challenging D&D task.

Background

- Building 39 was built as a 150,000 sq. ft. shop and fabrication facility.
- Room 16, in the north wing of the facility, has always been a dedicated beryllium machine shop.
- Room 16 is ~1800 sq. ft. with 22’ ceiling and a cement block enclosed mezzanine to house ventilation system.
- HVAC and exhaust ventilation system are independent from rest of building (mostly).
- Exhaust ventilation system consists of ductwork, dynamic precipitator, bag-house, HEPA filters, fan and stack.

Beryllium Shop Floor Plan

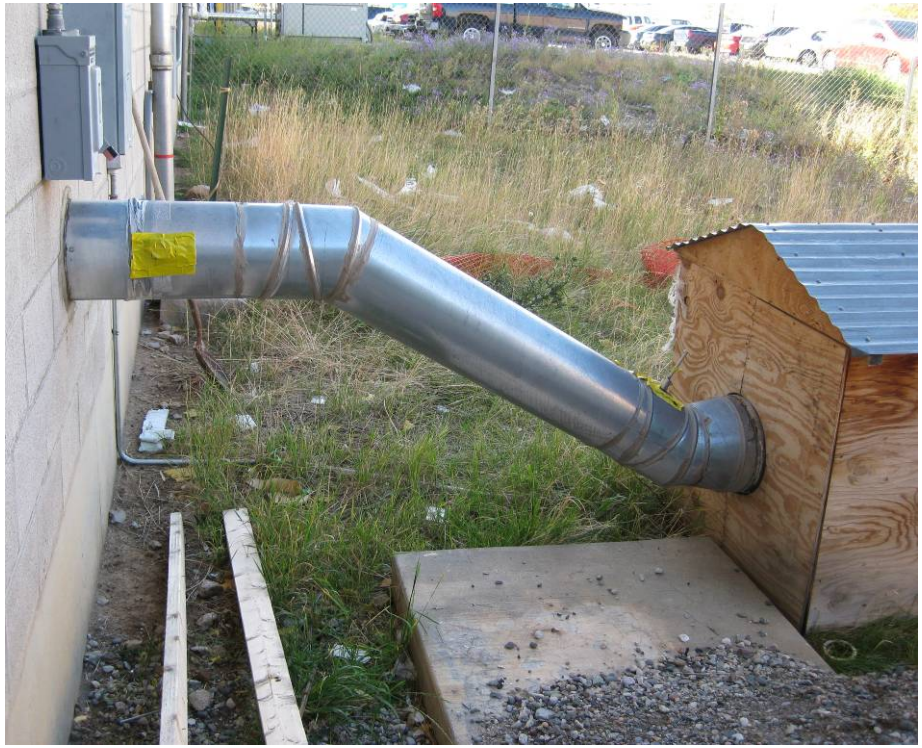


Shop is approximately 50’ x 36’. Elevated mezzanine in blue.
Main duct in yellow.

Supplemental Exterior Ventilation

- A problem with the dynamic precipitator in 2000 required a ventilation system shutdown for repairs.
- Ventilation system normally on 24/7 to keep shop negative in respect to hall. Concerns of contamination spread.
- Solution was a HEPA clean-air machine (~800 cfm) installed outside building and connected via a duct through the wall.
- This additional ventilation was not installed as part of this project, but it certainly provided an advantage and should be considered for similar jobs.

Supplemental Exterior Ventilation

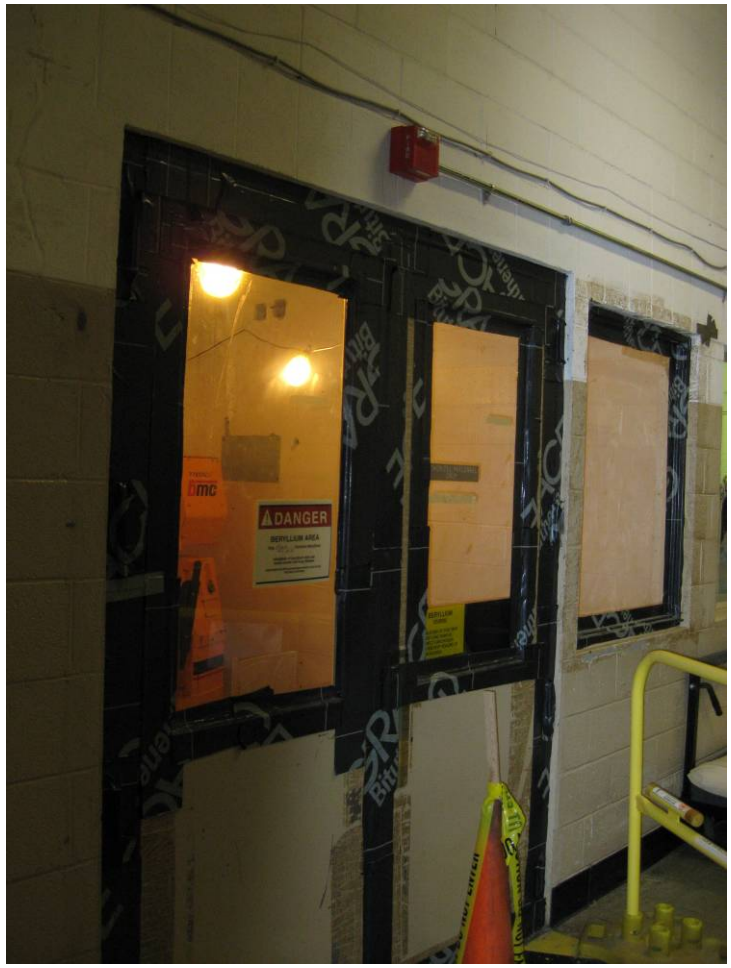


Supplemental Exterior Ventilation

Keeping Contamination In Unoccupied Shop

- When in operation the beryllium machine shop had daily cleaning; routine surface wipe samples were collected; ventilation system was checked daily; and air samples were collected for all machining operations.
- All this served to constantly monitor the situation and control contamination spread.
- Concerns were raised over how to maintain control when the shop was no longer operational and unoccupied.
- Chosen solution was to seal in the shop.

Sealing Shop Doors and Windows



Project Objectives

- Primary objective was to remove all beryllium to eliminate the potential exposure hazard to facility personnel, adjacent tenants and the environment.
- Remove and secure any potential classified parts that may be part of the “hold-up” in the duct and equipment.
- Remove beryllium from the building to reduce the Hazard Categorization of the facility from High to Low. This could save approximately $250 K per year in maintenance and operational costs.
- Return the space to useable condition.

Summary of Project

Project was broken down into two phases

- Phase I
  - Removal of ductwork and held-up material.
  - Removal of material from ventilation system hoppers.
  - Sectioning and packaging of ductwork.
  - Applying lessons learned to Phase II planning.
- Phase II
  - Dismantling, packaging and removal of ventilation system.
  - Removal of all remaining shop equipment and materials.
  - Removal of all fixtures and HVAC system.
  - Decontamination and painting of all surfaces.

General Health & Safety plan

- Engineering Controls
  - Shop ventilation system (for Phase I).
  - Clean air machine.
  - Portable HEPA ventilation system.
  - HEPA vacuums.
- Contamination Control
  - All but one door sealed.
  - Plastic wrap and bags.
  - Glove changes (multiple gloves, inner glove taped).
  - Spray cleaner and wipes.
  - Staged doffing areas.
  - Sticky mats.

General Health & Safety plan

- Personal Protective Equipment
  - Modesty scrubs, coveralls with hood and booties, taped inner gloves.
  - Outer gloves, outer booties, and outer coveralls (task dependent).
  - Full-face P100 APR or PAPR (task dependent).
  - PPE progressively doffed through buffer areas.
  - Shower at end of shift.
- Administrative
  - Access control; Signs and labels.
  - Training and Work Control.
  - Weekly planning meetings; Daily pre-job meetings.
  - Personal, area, and surface sampling.

Phase I: Remove the Ductwork

Before Phase I

After Phase I

Phase I: Empty the Hoppers

Dynamic Precipitator

Bag-house Hopper

Summary of Exposure Monitoring

Parameter	Phase I		Phase II	
N	42		94	
Mean	0.58 ug/m^3		0.40 ug/m^3	
SD	0.63 ug/m^3		1.32 ug/m^3	
Maximum	2.23 ug/m^3		11.8 ug/m^3	
< Reporting Limit	3	7.1%	24	25.5%
> Action Level	27	64.3%	31	33.0%
> PEL	2	4.8%	2	2.1%

Personal breathing zone samples; 8 hour TWA in ug/m^3.

Phase I: Highlights

- Crew safely removed ~300 linear feet of contaminated duct (Main, branch lines, and trunk hoses included).
- Duct waste was wrapped and stored in compliance with Fire Marshal and WMC for Phase II.
- Removed and secured one 30 gallon and four 55 gallon drums of Be security material. (~150 kg chips, dust, and debris from ducts and hoppers that may contain small classified parts or scraps.)
- Job completed ahead of schedule; without any safety incidents, spills, or releases; and with airborne levels of beryllium well below what had initially been anticipated.

Phase I: Notes & Lessons

- There was far more material retained in the ductwork than had been anticipated.
- Retained material was not just beryllium. It included other metals machined in the shop, cleaning tissues, rags, paper, household dust, and oil from lubricants.
- Initial estimate of 20 kg of beryllium was very low. More likely that 200 kg of beryllium was removed.
- Initial estimate was a best guess and was influenced by the relatively clean looking inlets to ducts and hoods and the inability to inspect the interior of hoppers.

Phase I: Notes & Lessons

- A great deal of credit must be given to the workers!
- Retention of experienced workers and staff for Phase II considered essential.
- During daily pre-job meetings and rest periods there were productive, interactive discussions between the workers, supervisors, project managers, and IH staff.
- Factors such as the placement of supplemental ventilation, the use of specific tools, and the handling of materials were rigorously discussed to determine ways to minimize airborne beryllium and prevent potential spills and contamination spread.

Phase II: Equipment & Material to be Removed

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Challenge: Removing Contaminated Items

How do we get this stuff out of here?

- The north wing of the building has a central hallway.
- The only doors to the old shop open onto this hallway.
- Occupants of the north wing are very concerned about beryllium exposure and contamination spread.
- Some items in shop are very large may be heavily contaminated.
- There is no space for a cleaning and packaging buffer area.

If No Door, Make a Door

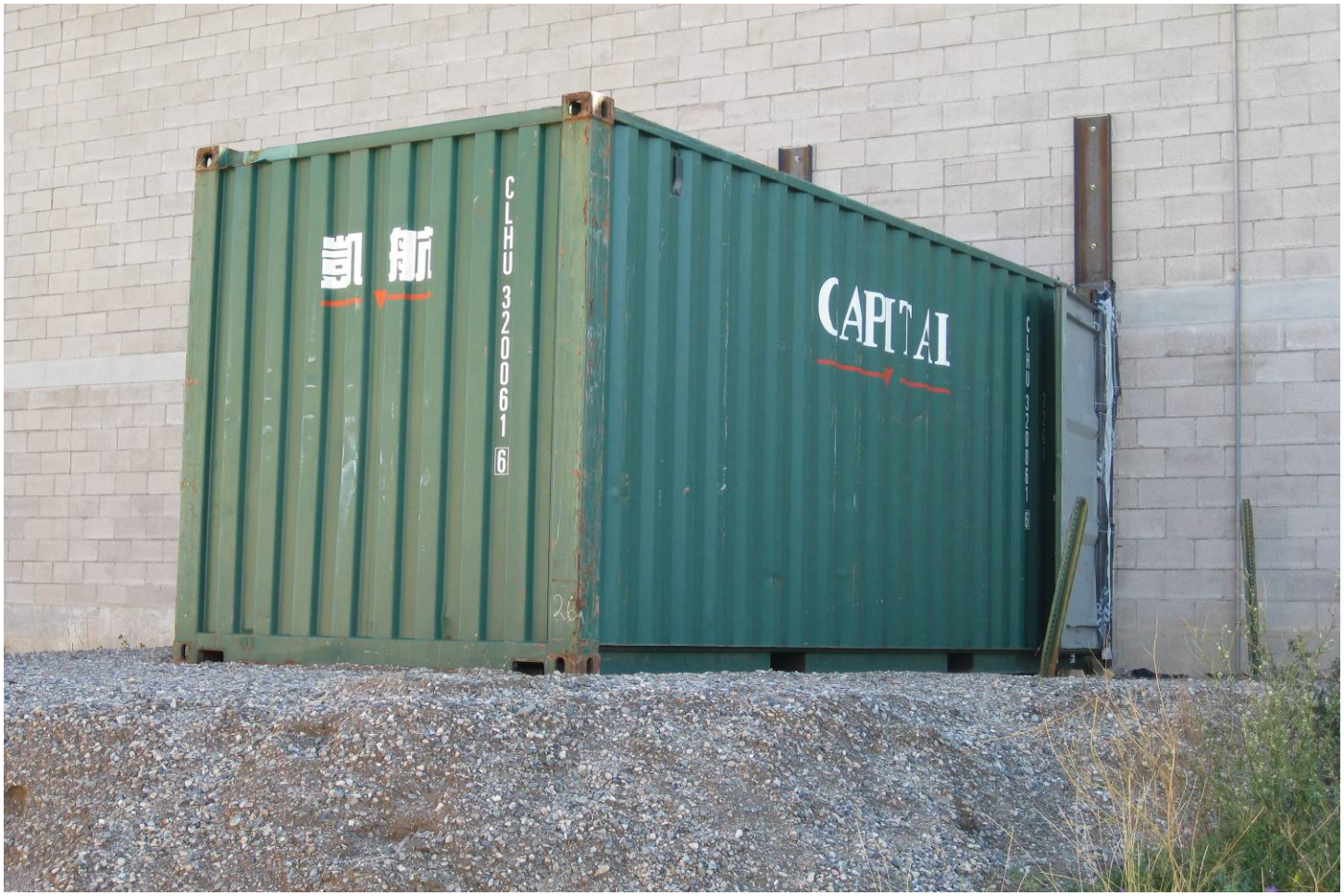
- Major security concern for limited area.
- A lot of work to come up with a plan that met all security requirements, was feasible to build, and would suit the purpose for which it was intended.
- Location must be selected, the area prepared, door fabricated, materials positioned, work scheduled, and everything ready to go before any wall penetration can be made.
- Must be installed and secured in one day unless guards are stationed.

Exterior Wall of Shop

Interior View of Added Door

Transportainer Sealed to Exterior Door Frame

Transportainer Sealed to Exterior Door Frame



Packing Transportainer With Waste

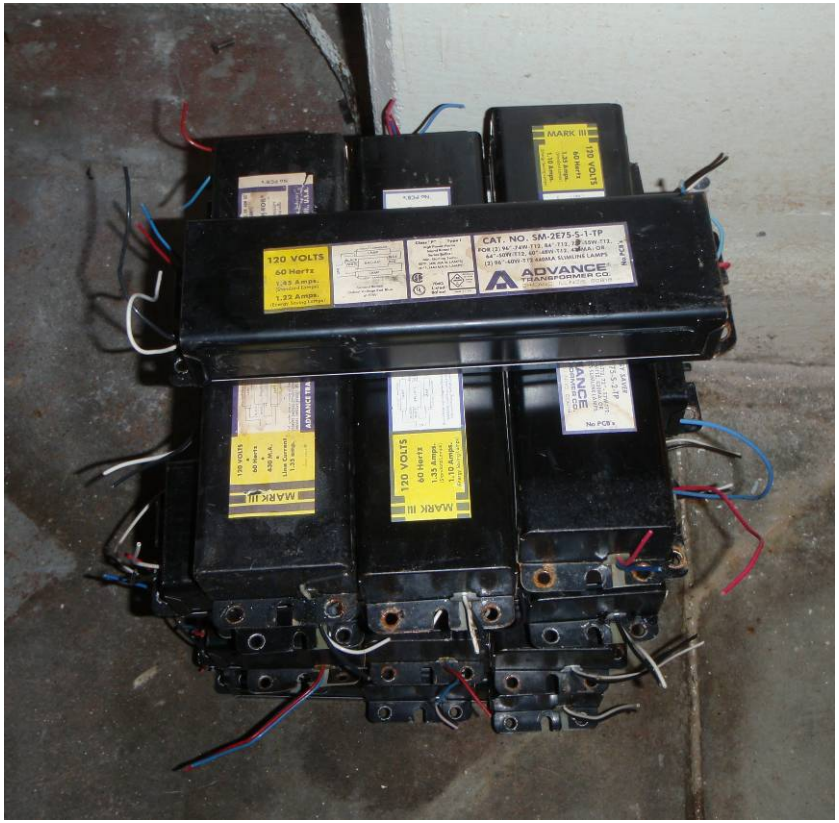
Packing Transportainer With Waste

Sealing Packed Transportainer

Issue: Keeping Waste Streams Separate

- Machines may contain unexpected subcomponents.
- Required transportainer “dumpster diving” and re-packing.

Issue: Keeping Waste “Clean”



- Hazardous wastes had separate disposal pathways.
- Decontamination of surfaces required before disposal.

Ventilation System in Mezzanine

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Ventilation System in Mezzanine

Another Challenge: Accessing Mezzanine

- The only mezzanine access was through an elevated door that opened onto a platform above the north wing hallway.
- The narrow metal platform and ladder were removed during an earlier ventilation system repair and replaced with a temporary platform and stair.
- During Phase I workers accessed mezzanine through the hallway door. Workers exited the space through a buffer area that allowed doffing outer PPE.
- Not considered acceptable for Phase II. No materials out through hallway.

Solution: Keep Door Sealed; Knock Out Wall

- Door to hall remained sealed.
- Knock out back wall of mezzanine into shop.

Breaking Down the Bag-House

- Limited space and concerns over small classified parts required the bag-house to be dismantled.
- Inlet and outlet ducts removed. Door was opened and a portable HEPA exhaust system was attached to bag-house outlet, creating a “hood” for bag removal.
- All bags removed, packaged, and secured in drum.
- Top of hopper covered with plywood and upper bag-house dismantled.
- Dust HEPA vacuumed from hoppers. Hoppers inspected.
- Pieces wrapped and removed with crane.

Tools of the Trade: Soon to be Trash

Getting It Down: Crane, Scaffold, Ladders

God Makes it Interesting: Hail Damages Roof

Significant Hazard: Heat Stress

Near the End, Almost Finished

Near the End, Almost Finished

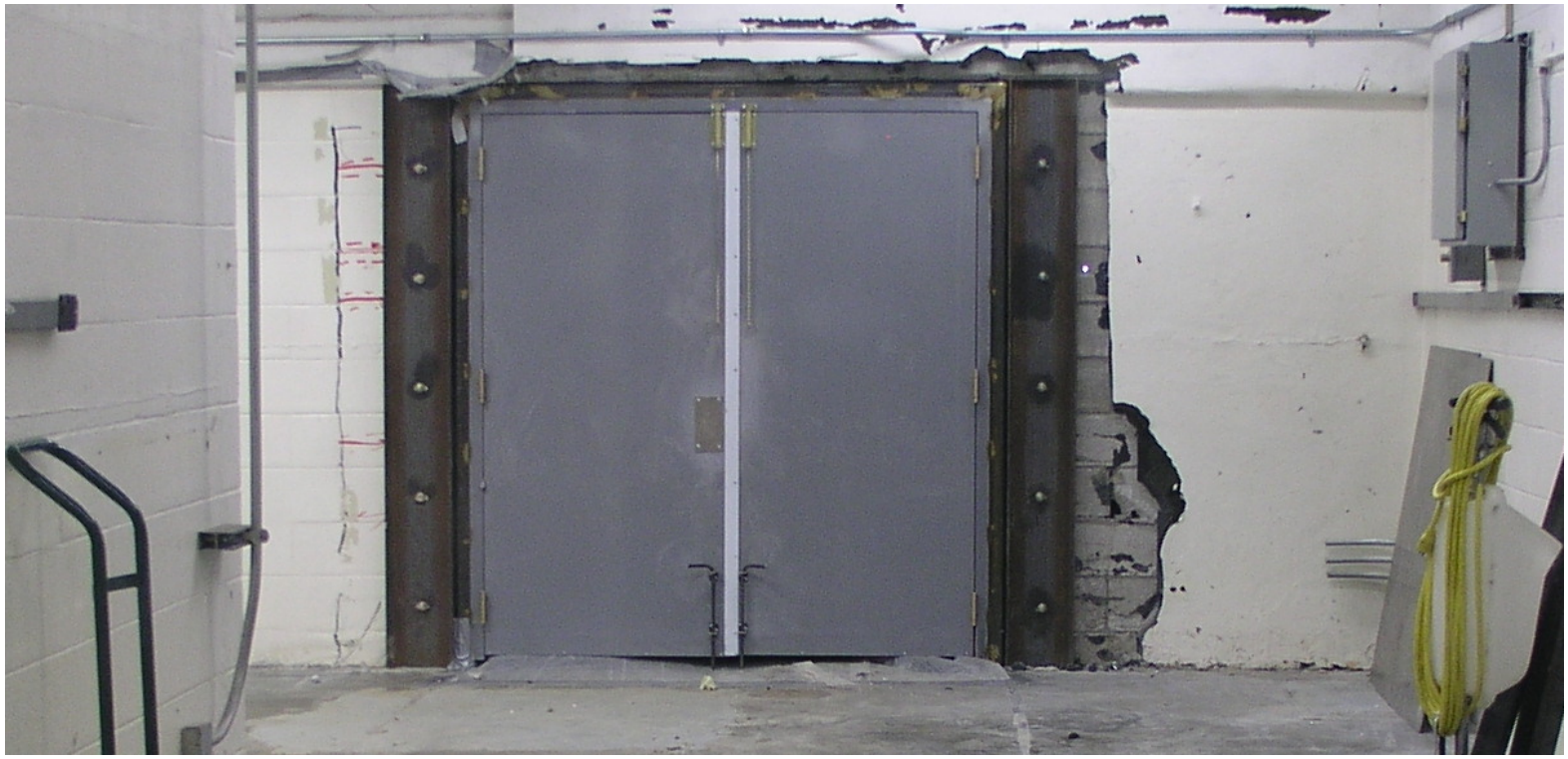
Lesson: Work Control

- Good intention to get work done, but did not follow work plan.
- No beryllium involved, but work control failure a serious concern.
- 40 day stand-down; $157 K cost to project; Supervisor lost job.

Key to Success: Qualified, Experienced Workers

- These are the people that make things happen.
- Listen to them and keep them involved in all aspects of job.

Surprises: Stink-Board and the Big Cat Litter Payout



- Note covering on block wall to right of door. Foamglas®
- When wall was opened, “kitty litter” poured out. Vermiculite

Issue: Tight Budget

- Even small unanticipated conditions, events, difficulties and “surprises” can lead to increased costs.
- With this level of beryllium you must complete the job properly. No shortcuts or cut corners!
- Recommendation: Estimate costs as best you can; add 25%; then secure funding.
- Be prepared to fight!
- Experienced and effective project managers are an essential element of the process.

Sampling to Evaluate Decontamination Efforts

- Visual Sample Plan (VSP) software used to develop sampling plan.
- Two areas identified:
  - Main room 16
  - Mezzanine and rooms 17 & 18

- Surface samples collected following LANL procedure.
- Air samples collected following OSHA ID-125G.

Final Steps

If decontamination is adequate:

- Floor will be surfaced with a filler/sealant.
- All surfaces will painted a dark color (e.g. deep red).
- Top coat of a lighter, contrasting color (e.g. beige) will be applied so wear through the top coat will be visable.
- Install new lighting and electrical.

If not:

- Clean again then re-sample.

Questions

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